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ENTOMOLOGICAL DATA FROM TREATED TREES

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ASHLAND, OREGON
DECEMBER 27, 1918

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ENTOMOLOGICAL DATA

from

TREATED TREES.

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KAWEAH PROJECT

UNIT 10.

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Ashland, Oregon,

December 27, 1918.

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ENTOMOLOGICAL DATA FROM TREATED TREES.

KAWEAH PROJECT- UNIT 10.

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Section I. Limitations of Data.

Aside from the data pertaining to the practical features of control work presented in the Conference Plan Report of December 12th, no accurate analysis can be made of the total infestation existing on the unit in the spring of 1918. Records kept during the progress of the work from April 8 to May 20 give a fairly reliable index to the character and amount of infestation in the treated trees only.

The infestation of the untreated trees left on the area is, therefore however, to a great extent an unknown quantity, for the reason that we have only cruising records for such trees, and an examination of the base does not always indicate with any degree of certainty the amount or character of the infestation which exists in the upper part of the tree.

Only by a very close study of the exact amount of bark surface infested by each species, will it be possible to analyze the infestation on a more satisfactory basis than given in the following tables. The bark surface method has its limitations as well, however, for the reasons that mixed infestation sometimes occurs within the same area of bark

surface, and that there may be great variation in the amount of infestation existing in equal areas of bark surface even in the same tree. For practical purposes a comparison of the board foot volumes of the trees killed by different species of insects is about the only basis upon which we can analyze the infestation to determine the percentage which was removed. To have studied the infestation from a bark surface standpoint would have required more time than was available in the administration of the control work on this project. The following data, compiled from the records of infested trees, discusses the factors which modify the analysis of the infestation as given in the Conference Plan Report.

Section II. Primary Infestation as Determined by Cruising Records.

The amount of timber killed by the various species of insects and other causes as recorded in the treated trees of Unit 10 was classified from a basal examination as follows:

--Yellow Pine.--

	No.trees	Volume	% of Total
Dendroctonus brevicomis	71	176,430	84.2
Dendroctonus monticolae	6	1,220	.6
Doubtful trees-cause undetermined from a basal examination	10	31,930	15.2
	87	209,580	100

--Sugar Pine--

	No.trees	Volume	% of Total
Dendroctonus monticolae	41	144,290	85.4
Doubtful trees-cause undetermined from a basal examination	4	24,730	14.6
	45	169,020	100

No claim can be made that this comparison represents the exact relative amounts of infestation existing on the area at the time of control work. After the trees were felled and examined many factors entered into the problem which modify this comparison. For example, species of Ips were recorded in the tops of trees killed by Dendroctonus. Dendroctonus monticolae was occasionally mixed with D. brevicomis, although in a secondary capacity. Some of the trees which are included in the treated volume were so nearly abandoned by the Dendroctonus beetles at the time of treatment that their board foot volume was entirely out of proportion to the number of beetles in the infested bark.

Section III. Control Records of Infestation in Yellow Pine.

The treated trees which were marked upon the area could be distinguished by the cruiser before they were felled as follows:

		No. trees	Volume
Class I.	Positive trees; those in which the primary infesting species could be readily determined from a basal examination	77	177,650
Class II.	Doubtful trees; those in which the primary infesting insects cannot be detected from a basal examination; this includes top-killed trees and also those in which the entire foliage may be fading	10	31,330
	Total --	87	208,980

Trees of Class I, which were so completely infested as to leave little doubt as to the cause of their death, have been grouped according to the primary insect responsible, as follows:

	No. trees.	Volume
D. brevicomis	71	175,430
D. monticolae	6	1,220
Total---	77	176,650

1. Dendroctonus brevicomis.

Of the 71 trees in which this species was recorded as primary, we find that in some cases brevicomis was the only tree killing beetle observed, while in other trees we have besides brevicomis a small amount of infestation from other species, apparently secondary in this case, but which are considered

capable of attacking and killing living trees. These compare as follows:

	No.trees	Volume.
1. Trees in which D. brevicomis only was recorded	43	87,600
2. Trees in which D. brevicomis was recorded as primary but associated with D. monticolae and Ips attacks in the tops	28	88,830
	71	176,430

At the time that control work was under way in April and May, broods in a majority of the trees were found in advanced stages and in some cases a considerable number of the new beetles had emerged. Emergence in some trees had advanced to a point where the advantages of treating the tree were questionable. Trees partially abandoned compare with those containing full broods as follows:

	No.trees	Volume
Containing full broods	58	139,590
* Partially abandoned	10	33,690
No records	3	3,150
	71	176, 430

Broods in many trees were overlapping owing to the fact that frequently a tree is not attacked uniformly over its entire length at the same time. An attack near the top may develop into larvae before eggs are deposited near the base. In some records all stages of the beetle are recorded in the same tree. The records are not considered complete

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* In addition to these, 5 partially abandoned trees, amounting to 19,410 board feet were marked but left untreated on the area.

or always accurate, but they show in a general way the proportion of the various stages which were found.

Stages of Insect	No. of times recorded in individual trees.
Parent Adults	9
Eggs	6
Larvae young to half grown	19
Half grown to full grown	64
Pupae	54
New Adults	42
Emergence	12
New Attack	

This comparison shows that by far the greater proportion of the D. brevicomis broods had reached the full grown larval stage and that pupae and new adults were abundant. All records apply to trees which were attacked sometime in the summer or fall of 1917, and in which the broods overwintered until the spring of 1918. No trees which were considered to have been attacked in the spring of 1918 were found on Unit 10 at the time of control work.

2. Dendroctonus monticolae.

Yellow pine trees in which this species was recorded can be classed as follows:

	No.trees	Volume
I. Trees in which D. monticolae was the only primary insect	6	1220
II. Trees in which D. monticolae is associated with D.brevicomis, but in a secondary capacity	22	81500

In Class II the actual amount of infestation as a rule was confined to the bark surface near the extreme top of the trees, usually not extending more than 20 feet below the top. When the infestation did extend below the upper 20 feet of height it was found to be mixed in the same infested bark surface with D. brevicomis in such a manner that it would have been very difficult to distinguish the actual volume of infestation for either species.

	No.trees	Volume
D. monticolae recorded only in upper 20 feet or less of infested length	17	63550
D. monticolae recorded on main trunk extending below upper 20 feet of infested length	5	17950
	22	81500

5. Ips Infestation.

Three species of Ips were encountered in yellow pine. They were:

Ips emarginatus

Ips oregonis

Ips confusus

Ips emarginatus was distinguished in field records, but no careful effort was made in the field to distinguish between oregonis and confusus. Specimens collected from four trees were compared and determined at the Pacific Slope Station. It was found that from two trees which were top-killed the broods consisted entirely of Ips oregonis, while from the other two trees only Ips confusus was collected.

Records of all species of Ips refer to their occurrence in the tops and limbs, in nearly all cases associated with the attacks of D. brevicomis or D. monticolae which occurred in the main bole. Very little if any of the bark infested by Ips was found on that part of the tree which includes in the merchantable volume. For this reason volumes have been disregarded in considering Ips infestation. The following shows the number of trees in which Ips were recorded and the primary species of Dendroctonus with which they were associated.

	Ips oregonis and confusus	Ips emarginatus.
Associated with D. monticolae and D. brevicomis	5	4
Associated with D. brevicomis only	4	
" " D. monticolae "	1	
Total	10	4

4. Doubtful Trees.

There were all told on the area covered by control work 17 yellow pine trees with fading or partially fading foliage in which no insects could be detected by the cruiser. These amounted to a volume of 57,040 feet, or approximately, 23% as much as the volume of the positive trees on the treated portion of the area. The decision in regard to treating or leaving such trees is something of a problem for the reason that the amount of infested bark which they contain above the green base may or may not constitute a considerable part of the primary infestation on the area. For this reason it is considered that trees of doubtful infestation deserve a rather careful study in order to determine the amount and character of the infestation which they contain. With this purpose in view ten of these doubtful trees with a volume of 31,930 board feet were felled and examined. The infested portions of the trees in most cases were treated.

From a basal examination of the doubtful trees as they stood, it was possible to separate them fairly easily into two classes.

1. Distinct top-killed trees; only part of foliage faded, remainder of tree green; these trees will survive as spike tops unless reinfested.

2. Dying trees; foliage may be partially or entirely fading, but it is apparent that trees will not survive, although no insects can be detected from a basal examination.

Each of the ten trees which were felled and examined was found to differ in some respect from all of the others, so that it is difficult to show the character of the infestation found, except by giving the notes from each individual tree. These are shown in table form as follows:

-- Class I. Top-killed Trees.--

Treated Trees.

Tree	Vol.	Ht.	Foliage	Uninfested Base	Infested Top
TA-11	4100	130	40 ft.at top fading:	60 ft.	D. brevicomis- 60 to 70 feet D. monticolae- 70 to 130 feet Ips emarginatus mixed with D. monticolae near top.
TA-29	710	100	40 " " " "	30 "	D. brevicomis 30 to 100 feet mixed with D. monticolae which predominates near top.
TA-81	2000	100	30 " " " "	40 "	D. brevicomis 30 to 100 feet mixed with D. monticolae
TA-98	3300	150	50 " " " "	100 ft	D. monticolae 100 to 150 feet
TA-119	2300	110	40 " " " "	60 ft	D. monticolae, 60 to 100 feet Ips oregonis, 100 to 110 feet. Some D.brevicomis mixed with D.monticolae
TA-120	1260	110	30 " " " "	75 "	D. monticolae 75 to 100 feet Ips oregonis 100 to 110 feet. Some D.brevicomis mixed with D.monticolae

Untreated Trees.*

TA- 67	1040	120	10 ft.at top fading:		L:
TA- 68	2010	140	20 " " " "		
TA- 70	7900	120	20 " " " "		
TA- 74	5600	130	15 " " " "		
TA- 75	6100	130	15 " " " "		
TA-100	960	110	Lower branches green		

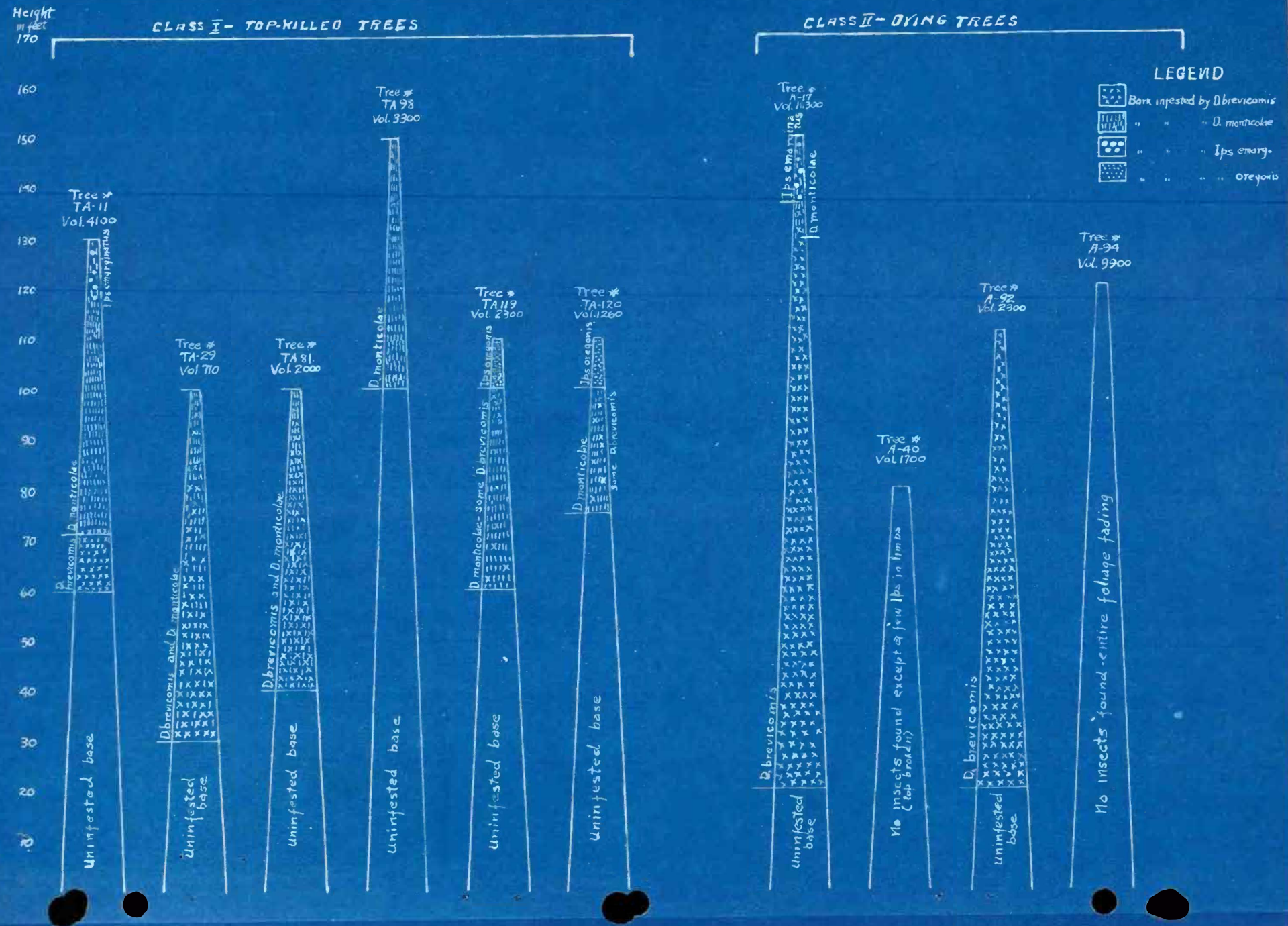
--Class II. Dying Trees--

Treated Trees.

A-17	11300	150	All fading except lower limbs	20 ft	D. brevicomis, 20 to 140 feet D. monticolae, 130 to 150 " Ips emarginatus, 135 to 150 feet
A-40	1700	80	Entirely fading		No insects found except a few Ips in limbs
A-92	2300	110	90 ft. fading- a few limbs green	20 ft	D.brevicomis, 20 to 100 feet
A-94	2900	120	Entirely fading		No insects found

* As these trees were left standing the infestation in the top was not determined.

DIAGRAM OF INFESTATION FOUND IN DOUBTFUL TREES.



A comparison of the infestation in the trees which were cut is still further shown in the diagram on page 13. It will be seen that in the top-killed trees D. monticolae occurs in all of them and is usually the predominating species. In the dying trees D. brevicomis was either the predominating insect or else no insects at all could be found. It will require, however, records from a much larger series of trees before any definite conclusions can be drawn as to the character of the infestation in top-killed and dying trees.

In the examination of September, 1918 it was found that of the six top-killed trees which were left standing on the area, four of them had been reinfested at the base by D. brevicomis and they were re-marked as B trees.

Section IV. Control Records of Infestation in Sugar Pine.

The sugar pine on the area, like the yellow pine, could also be separated by the cruiser into two main classes. These classes as applied to trees on the treated part of the area stand as follows:

	No. trees	Volume
Class I. Positive trees	41	144,290
Class II. Doubtful trees	4	24,730
Total--	45	169,020

1. Dendroctonus monticolae.

The trees of Class I were in all cases found to be infested by D. monticolae and the records do not show that any secondary infesting insects were present. Positive trees were, however, separated after treatment as follows:

	No. trees	Volume
1. Containing full broods infested from base nearly to top	28	67,070
2. Partially abandoned, infested base, but near top broods had emerged the previous year	12	72,400
3. No record of brood	1	4,820

Trees of the first division were on the whole good control trees as their treatment resulted in the removal of numbers of strong broods.

The treatment of the partially abandoned trees was, however, in many cases questionable, as it was found that, aside from a few broods near the base, scarcely any insects at all were found in the tree. Such trees probably represent the doubtful class of the preceding year, having been attacked by broods which emerged in 1917 and the green base was later infested by broods which overwintered until the spring of 1918. From

a basal examination, however, it was very difficult, if not impossible, to tell how far the infestation extended above the base and in nearly all cases the fact that a considerable part of the tree was abandoned could not be determined until after the tree was felled. When these trees were cut the infested portion only was treated and the remainder left. Some idea of the conditions found in these trees may be gained by the following table:

Tree No.	Vol.	Ht.	Infested Base	Abandoned Top	% of Beetles which had emerged.
A- 50	6810	170'	65 ft.	90 ft.	75 %
A- 60	8720	150	40 "	110 "	85 %
A- 71	6980	150	50 "	100 "	75 %
A- 72	5440	130	70 "	60 "	50 %
A-102	4450	140	60 "	80 "	50 %
A-126	14560	170	A few stragglers		99 %
A-137	8010	190	30 ft.	160	75 %
A-140	2130	120			99 %
A-143	200	60	stragglers		99 %
A-149	7420	175			50 %
A-148	6810	190			50 %
A-156	200	60			50 %
12	71730				

In approximately 50% of the trees, broods had advanced to the pupal and new adult stage, and burning was considered necessary to eliminate them. In the remaining 50%, broods had not advanced beyond the larval or first pupal stages. Generally the broods were in a considerably advanced condition. Some idea of this may be gained from the following table:

Stage of Insect	No. times recorded in individual trees.
Parent Adults	6
Eggs	1
Young to one-half frown larvae	11
One-half to full grown larvae	34
Pupae	34
New Adults	28
Emergence	10

2. Doubtful Trees.

All trees of the doubtful class were felled and examined. The following show conditions found:

Tree	Vol.	Ht.	Foliage	Uninfested Base	Infested Top.
A- 10	4100	125	Green except for a few limbs fading	20	D. monticolae, 20 to 100 ft.
A- 61	8720	150	70 feet at top fading	35	D. monticolae, 35 to 150 ft.
TA- 65	5440	170	Fading	Entire length	No insects found
A-109	6980	190	Red	20	D. monticolae 20 to 80 ft. 110 ft. of top abandoned

Two of the green trees based turned out to be good control trees, having strong broods above a short length of uninfested base. Tree No. A-109 was found to have the greater part of its length uninfested. Apparently, two generations of beetles had attacked this tree and still the lower 20 feet of the base was green. Tree No. Ta- 65 is one of the cases which will sometimes be encountered in control work and which cannot be explained upon the basis of our present knowledge.

Section V. Summary of Infestation as Modified by Control Data.

In modifying the original table on page 4, comparing the volumes of timber killed by various causes, it now seems fair to throw out of consideration the six top-killed yellow pines, as such trees would survive unless re-attacked, and only a small part of their volume can be included in the actual loss. The entire volume of the four trees classed as "dying" trees, however, can properly be included with the total loss, as such trees could not survive, whether reinfested or not. The same applies to the four doubtful sugar pines. Upon this basis the amount of timber killed by various causes can be classified as follows:

---Yellow Pine---

	No. trees	Volume	% of Total
Dendroctonus brevicomis	73	190,030	93.7
Dendroctonus monticolae	6	1,220	.6
Not killed by insects (Cause unknown)	2	11,600	5.7
	81	202,850	100

---Sugar Pine---

Dendroctonus monticolae	44	163,580	96.9
Not killed by insects (Cause unknown)	1	5,440	3.1
	45	169,020	100

Any comparison of the amount of infestation based upon the actual bark surface affected by the various causes can only be estimated with the data at present available. The following estimate is offered as representing something of the actual condition, although it is by no means vouched for:

-----Yellow Pine---

	Per Cent.
D. brevicomis----------	89.
D. monticolae----------	4.
Ips emarginatus----------	1.
Ips confusus----------	.5
Ips oregonis----------	.5
Not due to insects (cause not determined)	5.
	100

------ Sugar Pine------

D. monticolae----------	97
Not due to insects (cause not determined)	3
	100

Section VI. Miscellaneous Data.

---Predaceous and Secondary Insects.---

Throughout the progress of the work occasional records were made of other insects in the infested trees which were of secondary or predaceous habits. These records, however, were not kept with sufficient regularity to be of much value in showing the quantity of such insects, but can only be accepted to show their occurrence on the area.

Dendroctonus valens.

This species was noted occasionally in the stumps. We have five records of the occurrence in yellow pine and none in sugar pine. It is believed that the records are quite deficient in this respect, although it is evident that this species did not cut any figure in the primary infestation and that, on the Kaweah area, it was probably not as plentiful as is usual on control areas.

Aulonium longum.

Noted frequently, both in yellow pine and sugar pine. It was specially abundant in some of the partially abandoned trees.

Hypophloeus parallelus.

Usually occurring with Aulonium longum, but apparently not as plentiful.

Clerus sphegeus.

Noted occasionally, more frequently on infested sugar pine.

Trogosita viridicyanea.

A fairly common predator.

Foliage Records.

Aside from the doubtful trees, foliage records are available for 69 yellow pine and 37 sugar pine which were treated.

	Yellow Pine No. tree	Sugar Pine No. tree
Green		1
Fading	10	9
Sorrel	50	16
Red	9	11
	69	37

Mr. Wagner observed the area in June and July, but no fresh fading trees developed until after the new attacks of 1918 had occurred in the summer. This indicates that the foliage of nearly all overwintered trees had faded before the period of control work. In this respect the foliage conditions differed somewhat from those which have been observed on other areas where a considerable percentage of the foliage of overwintered trees did not fade until spring.

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